1,151,661

# PATENT SPECIFICATION

DRAWINGS ATTACHED

1,151,661

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COMPLETE SPECIFICATION

## Improvements in or relating to Fluid Valves

We, HONEYWELL INC., a Corporation organised and existing under the laws of the State of Delaware, United States of America, of 2747, Fourth Avenue South, Minneapolis 8, Minnesota, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fluid valves, and in particular to ball type valves in which there is a rotatable valve element in the form of a "ball", or substantially spherical plug.

The invention provides a fluid valve comprising a housing which includes a plug chamber and two passages leading from outside the housing into the plug chamber, a substantially spherical plug situated within the plug chamber and having a passageway passing through the plug, the plug being rotatable so that said passageway can either provide communication between the two passages or not, and means for rotating the plug, the cross-sectional shape of the passageway at one end of the passageway having a substantially V-shaped portion the apex of which is outwardly directed from the centre of the passageway at said one end.

Whilst the form of the plug is to be substantially spherical, it will be appreciated that certain departures from a perfect spherical shape are inevitable, for example where the passageway intersects the outer surface of the plug, and further that other departures may be necessary, for example to allow clearance between the plug and other parts of the valve, or, as will be described, to allow connection of an operating stem to the plug.

The degree of communication provided between the two passages by the passageway in the plug will depend, of course, upon the angular positioning of the plug relative to the housing, but it will be understood that, starting from a position where the plug completely prevents such communication, the plug can be rotated in such a direction that the initial communication will be through the "apex" part of the V-shaped portion, and continued rotation will gradually expose more of the V-shaped portion until eventually the whole cross-section of the passageway at the end having the V-shaped portion is open to the flow of fluid. An advantage of a valve in accordance with the invention is that the increase in communication during this gradual exposure of the V-shaped portion is less rapid than in prior valves not having the V-shaped portion, and consequently more precise control of fluid flow through the valve can be exercised during the initial stages of opening the valve.

It should be mentioned that the V-shaped portion need not be a precise geometric V, but that the apex may be to some extent rounded and the sides of the V may have some curvature, provided the generally tapering characteristic of the V-shape is not lost.

A fluid valve according to the invention preferably further comprises respective annular seals extending around the entrances of the two passages into the plug chamber, the seals making contact with the outer surface of the plug so as to seal the plug with respect to the plug chamber when the plug is positioned so as not to provide communication between said passages.

Each annular seal comprises, in a preferred embodiment of the invention, a first annular portion which is securely located inside the housing and a second annular portion which is carried by the first annular

portion, is flexible, and makes said contact with the outer surface of the plug, and preferably the first and second annular portions of the seal are integral with, and are joined together by, an intermediate annular portion of reduced thickness.

In use, a valve constructed in accordance with the invention provides enhanced streamline flow of fluid through the valve if said one end of the plug passageway which has a V-shaped cross-sectional portion faces upstream. In order that this advantage may be obtained for fluid flowing in either direction through the valve, and without any dismantling and re-assembly of the valve, preferably the plug is rotatable to positions in which the said one end of its passageway is aligned with either of the passages in the housing.

From the foregoing, it will be understood that the invention further comprehends a substantially spherical plug for a fluid valve, the plug having a passageway passing through it and the cross-sectional shape of the passageway at one end of the passageway having a substantially V-shaped outwardly directed portion.

In order that the invention may be more clearly understood, the preferred embodiment thereof will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which,

Figure 1 is a view of a substantially spherical plug showing that end of the passageway having the V-shaped portion,

Figure 2 is a cross-section through a fluid valve incorporating the plug shown in Figure 1,

Figure 3 is a cross-sectional view taken along the lines III-III of Figure 2;

Figure 4 is a cross-sectional view taken along the lines IV-IV of Figure 3;

Figure 5 illustrates graphically a comparison between the characteristics of conventional ball valves and valves according to the invention, and

Figure 6 illustrates graphically how greater sensitivity can be obtained by use of a valve according to the invention instead of a conventional ball valve.

It is convenient to refer firstly to Figure 2, in which a valve housing 10 has flanged end portions 12, 14 which contain a suitable number of apertures, 16, 18, 20, 22 through which the housing can be bolted to associated adjoining portions of a flanged pipe forming a flow line (not shown).

The housing 10, as shown in Figure 2, is almost symmetrical about a plane at right angles to the drawings and containing line III-III. Therefore only the left-hand (in the drawing) symmetrical half of the housing will be described, except where differences do occur.

A passage 108 leads from outside the housing into a plug chamber in which a substantially spherical plug 38 is situated. An annular seal 26 extends around the entrance of passage 108 into the plug chamber. The seal 26 has a first annular portion 28 which is a force fit in a recess 24 on the inside of the housing. A second, and flexible, annular portion 30 is carried by the first annular portion 28, and makes contact along its circumferential surface 34 with a surface 36 of the plug 38 when the latter is in the fully open position shown in Figure 2, and in the fully closed position where the plug 38 does not provide communication between passage 108 anl a corresponding passage 106 on the other side of the housing. The two seal portions 28 and 30 are integral with, and are joined together by, an intermediate annular portion 32 of reduced thickness, which allows portion 30 to flex. A similar seal 26 contacts the other side of the plug 38, and is similarly mounted, but instead of being mounted directly on the housing, is mounted in a force fit engagement with the innermost end of an annular seal retainer element 46.

The seal retainer 46 has an external annular groove 48 containing an O-ring seal 50 which is in fluid tight engagement with a bore 52 in housing 10. Pipe threads 54 on the outer surface of retainer 46 engage with threads 56 in the bore 52 of the housing 10, so that the retainer 46 can be screwed into the passage 106 to any required extent by engaging prongs of a wrench (not shown) in holds 60, 62, and turning the retainer 46. Thus the associated seal 26 can be compressed adjustably against the outer surface of plug 38.

The two seals 26 form the only support for the plug 38.

It can be seen that the passages 106 and 108 are of a frusto conical shape so as to form two ends of a venturi. A passageway 72 passing through the plug 38 forms the throat portion of this venturi, when the plug 38 is in the position of Figure 2.

From Figures 1, 3 and 4, it can be seen that the cross-sectional shape of the passageway 72 is generally cylindrical, but that at one end it has a substantially V-shaped outwardly directed portion. By "outwardly directed" we mean that the apex of the V points away from the centre of the passageway 72. The V-shaped portion is formed by certain portions of the wall of passageway 72 deviating inwardly from the cylindrical form as the end of the passageway is approached, until they meet the outer surface of the plug 38, where they define a cross-sectional shape having a V-shaped portion, the sides of the V being defined by the edges 74.

By means shortly to be described, the plug 38 can be rotated from the position of

Figure 2, where it provides full communication between passages 106 and 108, to either of two positions where it does not provide such communication, and in fact blocks both passages 106 and 108.

The top of the plug 38 has a recess 76 into which one end of a stem 79 of the valve extends, as is best shown in Figures 2 and 3. There is a slot 78, crossing the recess 76, into which a pin 80 which is freely mounted in the end of the stem 79 engages, whereby the plug 38 can be rotated by rotation of the stem 79.

Stem 79 extends through the upper wall of housing 10 in an oil impregnated bearing 82. The bearing 82 is a force fit in a cylindrical bore in a bonnet 84, which in turn is mounted by means of a gasket 86 and cap screws 87, 88, 89 and 90 on a portion 92 of the housing 10. An O-ring seal 94 is retained by the lower end of the bearing 82 and a shoulder 96, in fluid tight engagement with the stem 79.

A washer 98 loosely surrounds the lower end of the stem 79 to take up the wear that would otherwise take place between the top of the plug 38 and the lower end of the bonnet 84 when the stem and plug are rotated as a unit.

A pipe plug 100 is employed to provide access for cleaning out any sediment in the fluid that is passed through the valve and which may settle in the space between the lower surface 102 of the plug 38 and the lowermost inner surface 104 of the housing 10.

Figure 2 shows in solid lines the proper position of the V-shaped portion when a flowing stream of fluid is being directed from a flow line through the valve from right to left (as viewed in Figure 2). Figure 2 also shows in broken lines the proper position of the edges 74 when the flowing stream is in the opposite direction. As has already been mentioned, by having that end of passageway 72 which has the V-shaped cross-sectional portion facing upstream, the fluid flow through the valve is more streamlined than in a conventional ball-valve.

Figure 5 shows the relationship between port area and angular position of the plug for both a conventional ball valve and a ball valve as herein described, it being assumed that the latter valve is being correctly operated, that is, opened in such a direction that the apex of the V-shaped portion provides the initial communication between the inlet and outlet passages 106 and 108. The more gradual initial increase in port area, using a valve as described, is clearly seen, and results in more precise control of the fluid flow during the initial stage of valve opening.

Figure 6 is similar to Figure 5 but shows the flow coefficients, that is, the fluid coefficients of velocity, in the conventional and described types of valve in relation to the angular position of the plug. Again the improved sensitivity of the described valve during the initial opening stages is apparent. For example, Figure 6 shows that the plug of a valve as described must be rotated through 40° before this valve will permit the same flow of fluid to pass as a conventional valve whose plug has been rotated through 33°.

It should also be mentioned that the tapering edges 74 of the plug 38 as described, in conjunction with the seals 26, give a shearing action which cuts off the flow of slurries, such as paper pulp, particularly cleanly.

WHAT WE CLAIM IS:—

1. A fluid valve comprising a housing which includes a plug chamber and two passages leading from outside the housing into the plug chamber, a substantially spherical plug situated within the plug chamber and having a passageway passing through the plug, the plug being rotatable so that said passageway can either provide communication between the two passages or not, and means for rotating the plug, the cross-sectional shape of the passageway at one end of the passageway having a substantially V-shaped portion the apex of which is outwardly directed from the centre of the passageway at said one end.

2. A fluid valve according to claim 1 in which the passageway in the plug is generally cylindrical, and the V-shaped portion of its cross-section is formed by wall portions of the passageway deviating inwardly from the cylindrical form.

3. A valve according to claim 1 or claim 2 comprising respective annular seals extending around the entrances of the two passages into the plug chamber, the seals making contact with the outer surface of the plug so as to seal the plug with respect to the plug chamber when the plug is positioned so as not to provide communication between said passages.

4. A valve according to claim 3 in which each annular seal comprises a first annular portion which is securely located inside the housing and a second annular portion which is carried by the first annular portion, is flexible, and makes said contact with the outer surface of the plug.

5. A valve according to claim 4 in which the first and second annular portions of the seal are integral with, and are joined together by, an intermediate annular portion of reduced thickness.

6. A valve according to any one of claims 3 to 5, comprising means for adjustably compressing one of said annular seals against the outer surface of the plug.

7. A valve according to claim 6, in which said means comprises an annular element which screws into one of said passages, the inner most end of the annular element engaging with and locating said annular seal inside the housing, whereby said annular seal may be adjustably compressed against the outer surface of the plug by adjusting the extent to which the annular element is screwed into the passage.

8. A valve according to any one of the preceding claims in which the plug is rotatable to positions in which the said one end of its passageway is aligned with either of the passages in the housing.

9. A valve according to any one of the preceding claims in which the means for rotating the plug includes a stem extending through a wall of the housing, a pin at an end of the stem within the housing, and a slot in the spherical plug into which slot the pin engages whereby the plug can be rotated by rotation of the stem.

10. A substantially spherical plug for a fluid valve, the plug having a passageway passing through it and the cross-sectional shape of the passageway at one end of the passageway having a substantially V-shaped portion the apex of which is outwardly directed from the centre of the passageway at said one end.

11. A plug according to claim 10 in which the passageway in the plug is generally cylindrical, and the V-shaped portion of its cross-section is formed by wall portions of the passageway deviating inwardly from the cylindrical form.

12. A fluid valve constructed and arranged to operate substantially as hereinbefore described with reference to the accompanying drawings.

13. A plug for a fluid valve, the plug being constructed substantially as hereinbefore described with reference to the accompanying drawings.

For the Applicants,
R. A. BRIDE,
Chartered Patent Agent.

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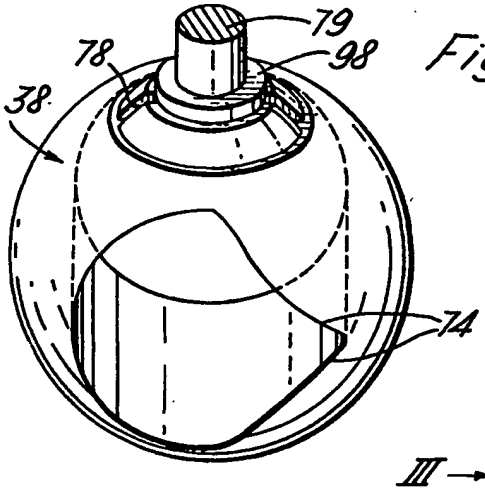


Fig. 1.

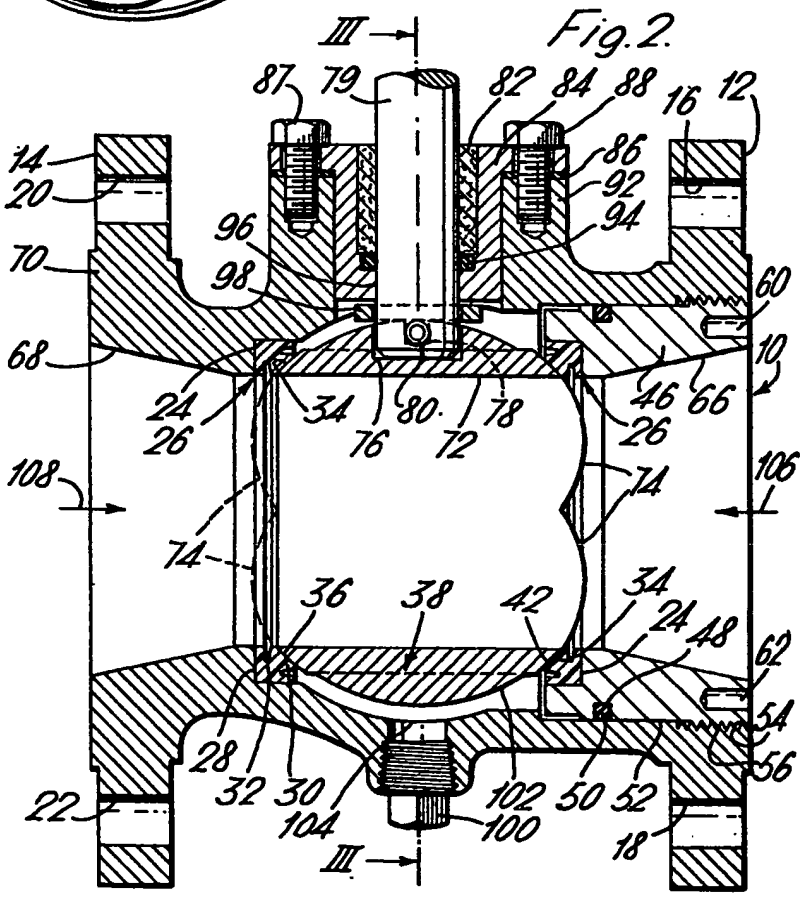


Fig. 2.

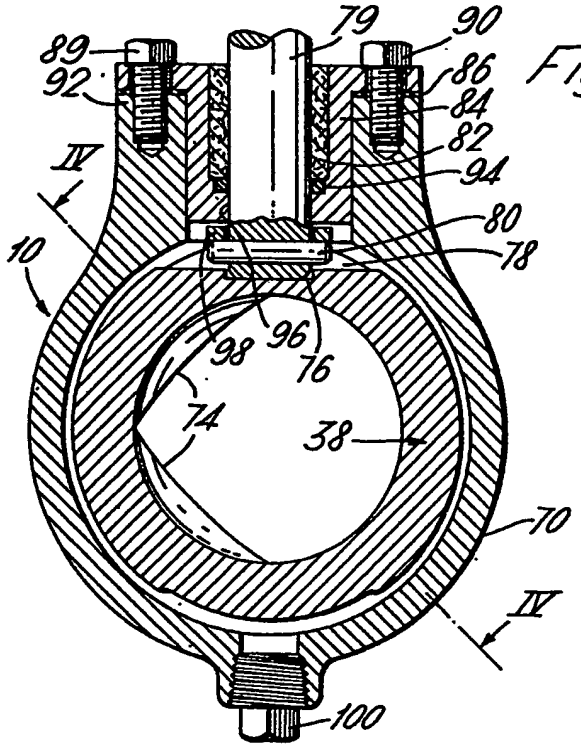


Fig. 3.

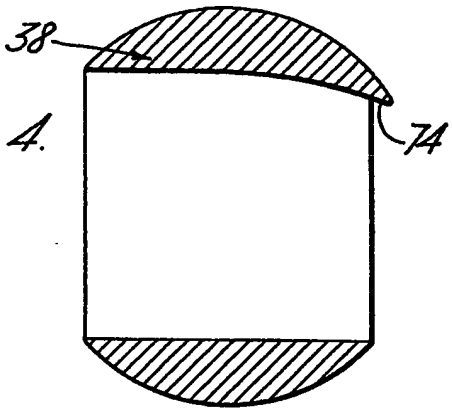


Fig. 4.

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SHEETS 2 &3

Fig.6.

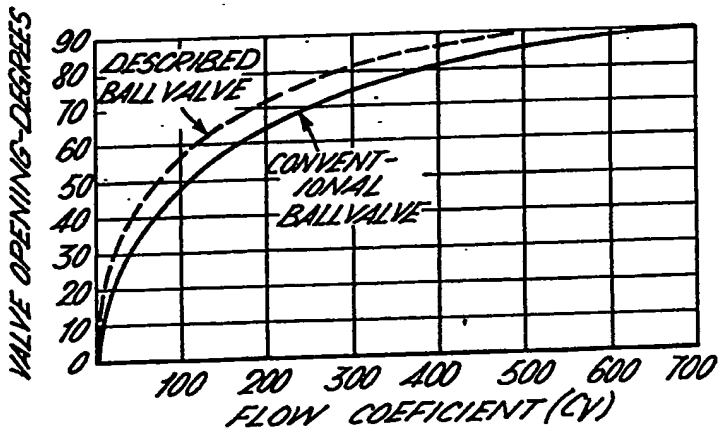
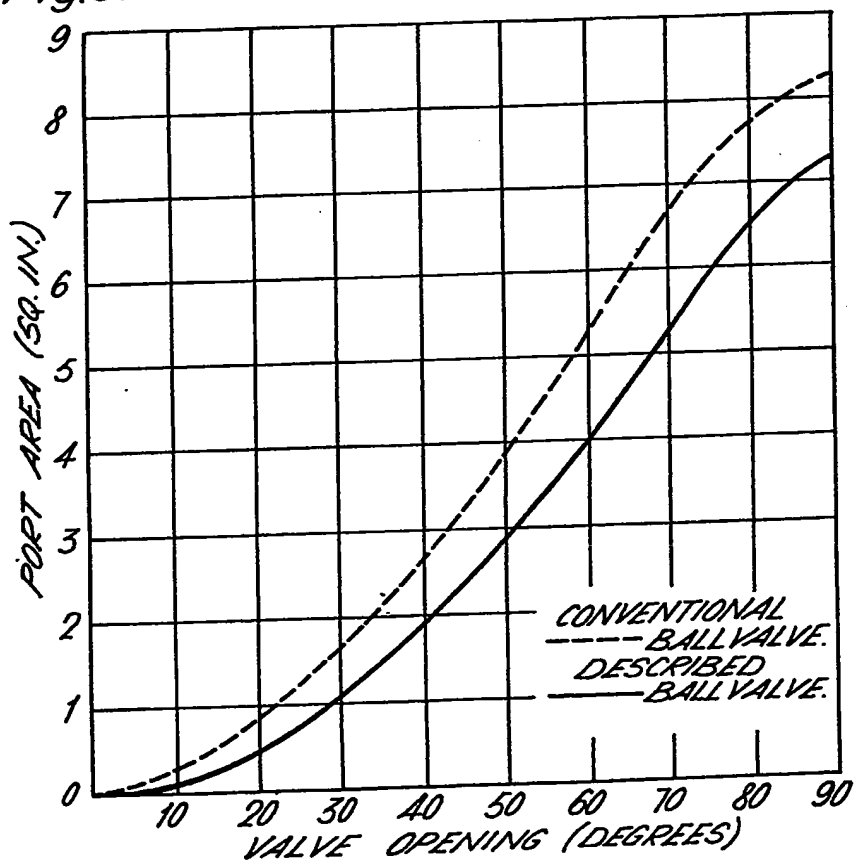



Fig.5.

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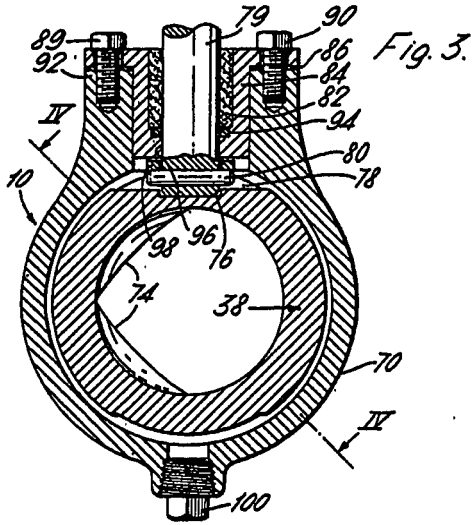


Fig. 3.

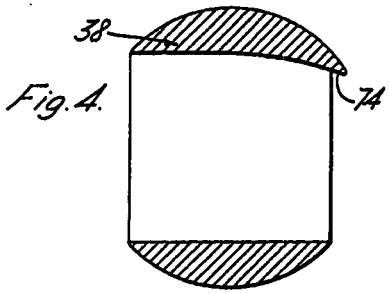


Fig. 4.

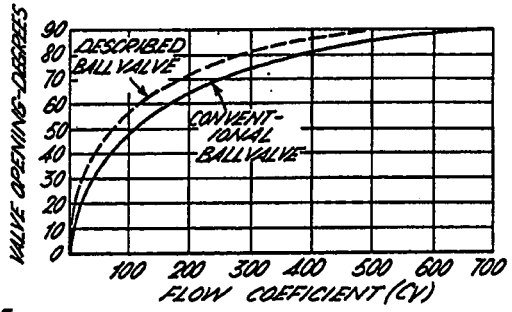


Fig.6.

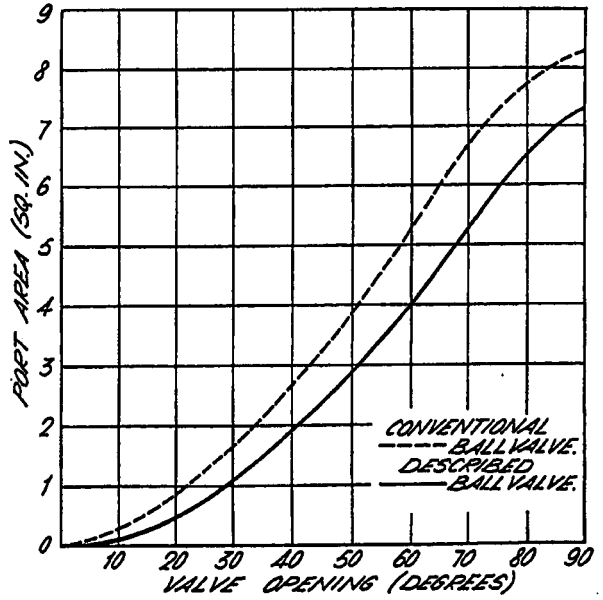


Fig.5.